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Engineers' Innovative Work Behavior: A Research with the Public Worker

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Abstract

The only way for the organization, to become more innovative is to capitalize on their employees' ability to create and to innovate. The purpose of this study is to understand the impact of demographic factors on innovative work behavior of engineers, working for 5th Highway Directorate in Turkey. The seven-item scale was used to assess employee innovative behaviors at the workplace. As a result most rated item by engineers, "I try to follow new techniques related to my job" is found. Furthermore, it is tested whether there are differences in the level of innovative work behaviors that can be attributed to demographic characteristics such as age, gender, experience, foreign language skills and found no significant differences according to demographic variables. The only significant difference has been found between positions of engineers and innovative work behavior.

Keywords: Individual innovation; innovative work behavior; Innovative Work Behavior Survey; Item analysis.

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1. Introduction

The term ‘innovation’ has many meanings. It can refer to the inventive process by which new things, ideas, and practices are developed; it can mean the new thing or idea itself; or it can be the “process whereby an existing innovation becomes a part of an adopter’s cognitive state and behavioral repertoire” [1]. The Accreditation Board for Engineering and Technology Outcomes Approach (ABET) in the USA pointed out “initiative and innovation” in its proposed skills for Engineering Criteria List [2].

Innovative work behavior is of inevitable importance to organizational effectiveness and survival skills [3, 4, 5, 6, 7]. Many practitioners and scientists now endorse the view that individual innovation helps to attain organizational thriving [8, 9, 10, 11, 12]. To realize innovation, employees need to be both eager and able to innovate personally. Innovation is central to several famous management theories, including corporate venturing [13], total quality management [14, 15], organizational climate [16, 17, 18, 19, 20, 21] continuous improvement schemes [22], Kaizen [23] and organizational learning [24]. In this current research, engineers’ innovative work behavior will be examined by means of the scale developed and inspired by authors in reference [4] in a six-item survey. The focus of this paper will also include a sub-research component related to the roles of demographic factors on innovative work behavior.

1.1Innovative Work Behavior

Individuals’ innovative behavior at the workplace is among the essentials of any high performance for an organization. Indeed, a key to organizational survival is the process of creative destruction where an organization needs to weed out old competences and consistently improve new ones [25]. Innovative work behaviors have been studied in terms of personality characteristics, outputs, and behaviors for instance, [26] emphasized general intent to change as a personality-based aspect of individual innovation. Authors in reference [27] Measure of role innovation captures how many changes an individual has initiated in his or her job in comparison to the last role. Authors in reference [10] measure assess individuals' self-ratings of their suggestions and realized innovations. In terms of cognitive constructs, why cognitive biases are known now, structures, and processes impact creativity [28, 29, 30]. Researchers suggest that creativity entails traits such as intelligence and intelligent thinking [31], creative self-efficacy [32, 33, 34]. Unconscious thought processes [35], and openness to experience [36], all of which support the potential for innovative behavior at the workplace. In terms of affect, researchers have found discrepant results in that both positive ways [9] and negative ways affect [37, 38] contribute to creativity, indicating the importance of intervening factors. Finally, there are numerous researches detailing how and why work environments [9, 11, 16] and especially leadership [9, 14, 30] are correlated with innovation. According to reference [6], when individuals experience positive moods at work, their creative thinking and problem solving skills are facilitated. It was found that, when people experience positive emotions like vitality, they broaden their thought-action repertoire [39]. He elaborated on this term “thought-action repertoire” to explain that positive emotions trigger changes in cognitive activities for innovation and creation. Innovative behavior is a multi-stage process of problem recognition, a generation of ideas or solutions, the building of support for ideas, and the idea of the implementation of new procedures [4, 18].

Creativity (i.e., the production of novel and useful ideas; reference [9] is thus an important part of innovative behavior. In addition to being affected by knowledge and abilities [9], innovative behaviors are discussed as a largely motivational issue [9]. This makes it of crucial interest to organization behavior researchers [16, 4]. According to reference [4] individual innovative behavior in the workplace have three stages: First, the individual recognizes a problem and comes up with new solutions and ideas. Second, the individual seeks ways to promote her or his solutions and ideas, and builds legitimacy and support both inside and outside the organization. Third, the individual makes the idea or solution concrete by producing a prototype or model of the innovation [18]. As such, innovative work behavior encompasses all three parts in this current research. It is thereby reasoned that self-perception of engineers may be an important catalyst of innovative behaviors at the workplace. According to the first dimensions of [4], learning and growing at work in a favorable position leads to the identification of problems and their relative solutions. Second, the dimension of vitality at work allows for the likelihood of the energy and motivation that is required to feed innovative thoughts. Vitality is the source of positive emotions that are experienced when a person is capable of and eager to engage in a particular behavior or attempt to undertake a risk [20, 21]. In addition, authors in reference [32] have shown that vitality facilitates employee involvement in innovation at work. Innovative work is not a status that is passive, and it requires promoting and championing ideas in a way that requires energy. Innovative work is a natural and proactive kind of manner [15] where individuals seek out new technologies, processes, and techniques.

2. Methodology

2.1. Measurement and Research Hypothesis

To examine engineers' self-perceived IWB scores and influential demographic factors, seven items developed and inspired by [4] were used to gather the required data. In the literature below, surveys are mostly in use.

Scott and Bruce	6 items	Managers of 172 engineers,	α = 0.89; significant correlation
Bunce and West 5 items	Sample 1	Sample 1	435 employees from a national
Spreitzer 4 items	Subordinates of 393 managers of	α = 0.91; no validity reported	an industrial company; Other- ratings, multiple source
Basu and Green 4 items	Supervisors of 225 employees of a	α = 0.93; no validity reported	Printing manufacturer; Other- ratings, single source
Kleysen and Street	14 items	225 employees from different organizations; Self-rating, single source	α = 0.97; no support of validity (inadequate fit of structural equation model)

Existing literature on innovation helped to improve the main and sub research hypotheses as seen below: Positive self-perception will be positively associated with innovative work behaviors for engineers. Self-perception of IWB varies according to demographic factors of engineers'.

2.2. Research Model

Analysis of the existing literature on innovation helped to improve the current research model as seen in Figure 1 below:

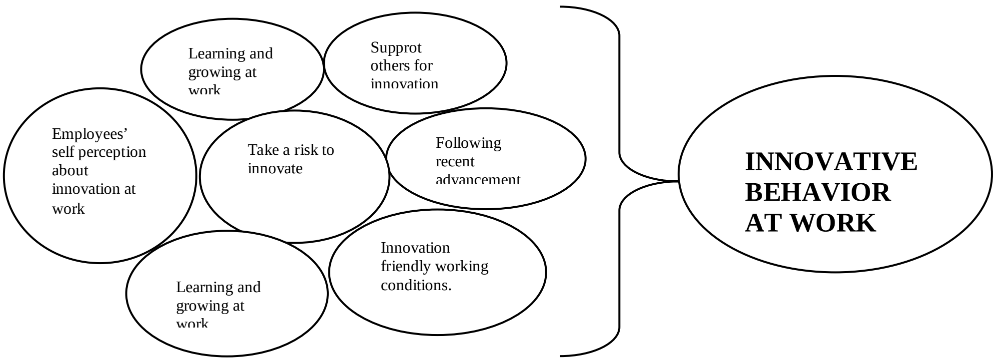

Figure 1: The Hypothesized Research Model.

2.3 Sampling and Procedure

This study was conducted in 2015 with the engineers of a large government organization located in Mersin/Turkey, the 5th Regional Directorate of Highways. The majority of employees are professional engineers, engineering administrative or engineer managers. The sample of the research is 65 engineers who agreed to participate in this research.

2.4 Measurement

To assess employee innovative behaviors at work, the 6-item scale developed by Scott and Bruce (1994) was translated in a scientific manner to the 7-item scale. Employees were asked to report on the extent to which they engage in and display innovative behaviors at work. The resulting sample items are provided in Table 4. Responses were made on a five-point Likert-type scale ranging from 1= "totally disagree" to 5 = "totally agree".

3. Findings

Engineers' self-perceptions about innovative work behavior have been examined and have been examined and the relative results are outlined below.

3.1 Some Statistics About The Sample

65 engineers were accepted to participate in the study. Of these; 30.8% of them were women and 69.2% were

men. 33.8% of the main group falls within the age range of 24-30 and 29.2% of the main group falls within the age range of 38-44. Thus, the majority of the sample group ranges between the ages of 24 and 44 years old. Another demographic variable of the sample is the tenure of the engineers. The majority of the sample has 1-10 years' experience, which is 56.4% of the total. Major proportion of the sample is comprised of engineer's administrative position with 83.2 percent, 9.2%, general and regional vice directorate of with 7.7%. Finally, the foreign language skills of engineers were asked. 63.1% speak a second language, and the rest of the sample, comprising 36.9%, has no foreign language skills. While 83.1% of the group report positively for self-perceived innovativeness, the rest of the sample rate themselves as not innovative (16.9%). Higher scores indicated a higher degree of innovativeness. Normality tests were ran by SPSS program features. Table 1 below shows that research data does not have significant value for Kolmogorov-Smirnov,(value is higher than 0.05). Therefore, it is assumed that the data is normally distributed.

Table 1: Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
IWB Score	0.097	65	0.200	0.963	65	0.146

a. Lilliefors Significance Correction

Table 2: Reliability Analysis

Cronbach Alpha Value	Number of Item
0,843	7

Table 3: Item Total Statistics

Item	Scale Mean if item deleted	Scale Variance if item deleted	Corrected item-total correlation	Cronbach's Alpha if item deleted
I1	21,7385	23,821	,684	,812
I2	22,2615	24,259	,448	,846
I3	21,8308	23,924	,646	,816
I4	23,0462	23,138	,497	,841
I5	22,3077	23,279	,649	,814
I6	22,0000	23,594	,694	,810
I7	22,2615	21,696	,663	,812

Despite the results of the normality test, the Skewness (-,809) and Kurtosis (+,923) values are also checked for normality, and in [40] as indicated in the aforementioned literature, values between -1.5 and +1.5 show that data is normally distributed.

The scale has a coefficient alpha of 0.843, illustrating that reliability of the questionnaire is of a very high degree. Considering total item correlations, Cronbach alpha value is calculated between 0,810 and 0,846, demonstrating that the scale is a reliable instrument. Considering into adjusted item correlations, it is seen that all values are higher than 0.25. In this case, all items are correlated and the reliability of the scale is found to be of a high degree.

Table 4: Item Explanation

Item Number	Explanation
I1	I try to follow new techniques related to my job.
I2	I attend conferences, congresses and seminars.
I3	I prefer to use new techniques and methods at my job.
I4	My working condition is suitable for innovation.
I5	I don’t hesitate to take risks at work.
I6	I support my peers for innovation.
I7	Innovation is an essential component of my job.

Table 5: Item Analysis

Items	Totally disagree		Disagree		No comment		Agree		Totally agree		Average	Sd.
	f	%	f	%	f	%	f	%	f	%		
I1	2	3,1	3	4,6	3	4,6	31	47,7	26	40	4,16	0,944
I2	7	10,8	4	6,2	8	12,3	32	49,2	14	21,5	3,64	1,20
I3	2	3,1	3	4,6	7	10,8	29	44,6	24	36,9	4,07	0,97
I4	12	18,5	15	23,1	16	24,6	14	21,5	8	12,3	2,86	1,29
I5	1	1,5	9	13,8	21	32,3	18	27,7	16	24,6	3,60	1,057
I6	1	1,5	6	9,2	9	13,8	31	47,7	18	27,7	3,90	0,96
I7	5	7,7	8	12,3	12	18,5	20	30,8	20	30,8	3,64	1,25

The most rated item is I1 with 40% totally agree and an average of 4.16 agreement out of five. Secondly, rated item is I3 with 36.9 totally agree rate value and average of 4.07 agreement out of five. The least rated item is I4 with totally disagree rate value of 18.5 percent and average of 2.86 agreement out of five

Hypothesis 1:

$H_{0:}$ Engineers’ IWB score does not vary according to sex.

H_1: Engineers’ IWB score does vary according to sex.

Table 6: Sex and IWB Scores t Test Result

Sex	N	Mean	Std. Deviation	df	T	P
F	20	3,48	0,84	63	-1,46	0,147
M	45	3,79	0,76			

The P result of the T test is calculated higher than 0.05 so hypothesis H_0 is accepted. Also, there is no difference regarding IWB scores according to sex of the engineers.

Hypothesis 2:

$H_{0:}$ Engineers' IWB score does not vary according to age.

H_1: Engineers' IWB score does vary according to age.

Table 7: IWB Scores and Age Anova Test Result

Source of Variance	Sum of Squares	df	Mean Square	F	P
Between Groups	1,79	4	0,44	0,69	0,598
Within Groups	38,72	60	0,64		
Total	40,51	64			

P value is found as 0,598 higher than 0.05 so there is no difference at IWB scores according to age of engineers.

Hypothesis 3:

$H_{0:}$ Engineers' IWB score does not vary according to position.

H_1: Engineers' IWB score does vary according to position.

Table 8: IWB Scores and Position Anova Test Result

Source of Variance	Sum of Squares	df	Mean Square	F	P
Between Groups	5,27	2	2,63	4,63	0,013
Within Groups	35,24	62	0,56		
Total	40,51	64			

P value has been found as 0,013 lower than 0.05 so there is a statistically significant difference at IWB scores according to age of engineers.

Table 9: IWB Scores According to Position

Position	Mean	N	Sd
Engineer	3.58	54	0.79
Head of the Engineer	4.52	6	0.58
Regional Vice and Gen. , Directorate	4.00	5	0.31
Total	3.70	65	0.79

The highest score, considering to position is the group head of engineer with 4.52 mean values. Engineer has the lowest mean 3.58, IWB score.

Hypothesis 4:

$H_{0:}$ Engineers' IWB score does not vary according to experience.

H_1: Engineers' IWB score does vary according to experience.

Table 10: IWB scores According to Experience Anova Result

Source of Variance	Sum of Squares	Df	Mean Square	F	P
Between Groups	2,64	3	0,88	1,42	0,246
Within Groups	37,87	61	0,62		
Total	40,51	64			

P value is calculated as 0,246 which is higher than 0.05 so there is no statistically significant difference between group according to engineer's experience.

Hypothesis 4:

$H_{0:}$ Engineers' IWB score does not vary according to foreign language skill.

H_1: Engineers' IWB score does vary according to foreign language skill.

Table 11: IWB scores According to Foreign Language Skill Anova Result

Source of Variance	Sum of Squares	df	Mean Square	F	P
Between Groups	1,72	3	0,57	0,90	0,44
Within Groups	38,79	61	0,63		
Total	40,51	64			

P value is calculated 0,88 which is higher than 0.05 so there is no statistically significant difference according to foreign language skills of engineers.

4. Conclusion and Discussion

The main purpose of this study is to understand the self-perceived innovative work behavior of employees. The results are in line with the existing literature, as the most rated item by engineers, “I try to follow new techniques related to my job” was highly correlated with development and vitality at the job [41]. According to reference [41], there are three stages of the innovation process: generation of ideas (production of new ideas and improvement of the recent ones); harvesting ideas (gathering, examining and evaluating the ideas); and developing and implementing the ideas (study, testing, enhancement and development of the ideas and implementing them).

All stages require development at job as an essential component of innovation. Besides other researchers in reference [16, 18, 27, 42], emphasizes the importance of being proactive to innovate, which is strongly related to development at job and Item 1. The less rated item in the scale is Item 4: “My working condition suitable for innovation.” Empirical support for a positive connection between providing resources and applicable behavior is widely available. A frequently mentioned example of providing resources for employees is that of 3M, the multinational company where scientists and R&D professionals are encouraged to spend 15 per cent of their working hours on their own innovative projects [43, 44]. Many researchers revealed the perceived working condition’s importance on innovative work behavior [45, 46, 47].

Also, perceptions of organizational climate and culture have been shown to influence organizational performance and effectiveness [48, 49, 50]. Since then, the literature has confirmed many times over that perceived support and working conditions are essential triggers of innovation. The directorate of highways should consider this finding in order to provide an innovation-friendly working environment. Contrary to previous literature findings about a significant relationship between gender, age, experience, foreign language skill and innovative work behavior, in this current study there are no significant relationship. In this research, it is tested whether there are differences in the level of innovative work behaviors that can be attributed to demographic characteristics such as age, gender, experience, foreign language skills and found no significant differences. The only significant difference has been found between positions of engineers and innovative work behavior. The highest rate belongs to supervisor of the engineers who are the technically experienced and who have not yet achieved an administrative role.

The literature on innovation in reference [42] emphasizes the role of individual factors such as age, gender, and level of education. According to reference [4], innovative behavior is the outcome of an extended process comprised of antecedents, processes, and results. The antecedents identified by authors in reference [4] are the demographics of the individual. Past research has consistently related level of education and tenure to innovative behaviors. In this study it was found that there is a statistically significant difference only between supervisor position and regular engineers’ IWB scores. Supervisory position engineer’s IWB score is higher than regular engineers’ IWB score based on self-perception.

These current findings are also in line with the findings that exist in the previous literature. In the research of [32], with the exception of gender, they did not find any significant effects of demographic characteristics on innovative behaviors. The results of the study have several implications for managerial practices and organizations emphasizing innovation, especially in terms of perceived innovation support and their willingness to develop new techniques and innovate at work. According to current research result, supervisory engineers IWB scores are higher than regular engineers which means human resource managers should motivate lower level engineers to innovate and create.

This study contains several limitations and can be further developed in future research. In this study, the random sampling method was used. Thus, generalizations may not be appropriate for the entire population of engineers. In addition, it did not examine specialties within engineering, which could have yielded differences in groups. Another limitation of the study is was not being longitudinal. As such, different results may be observed for long-term studies. Engineers' cultural background and income was not examined, both of which could have possibly yielded differences in innovative work behavior.

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